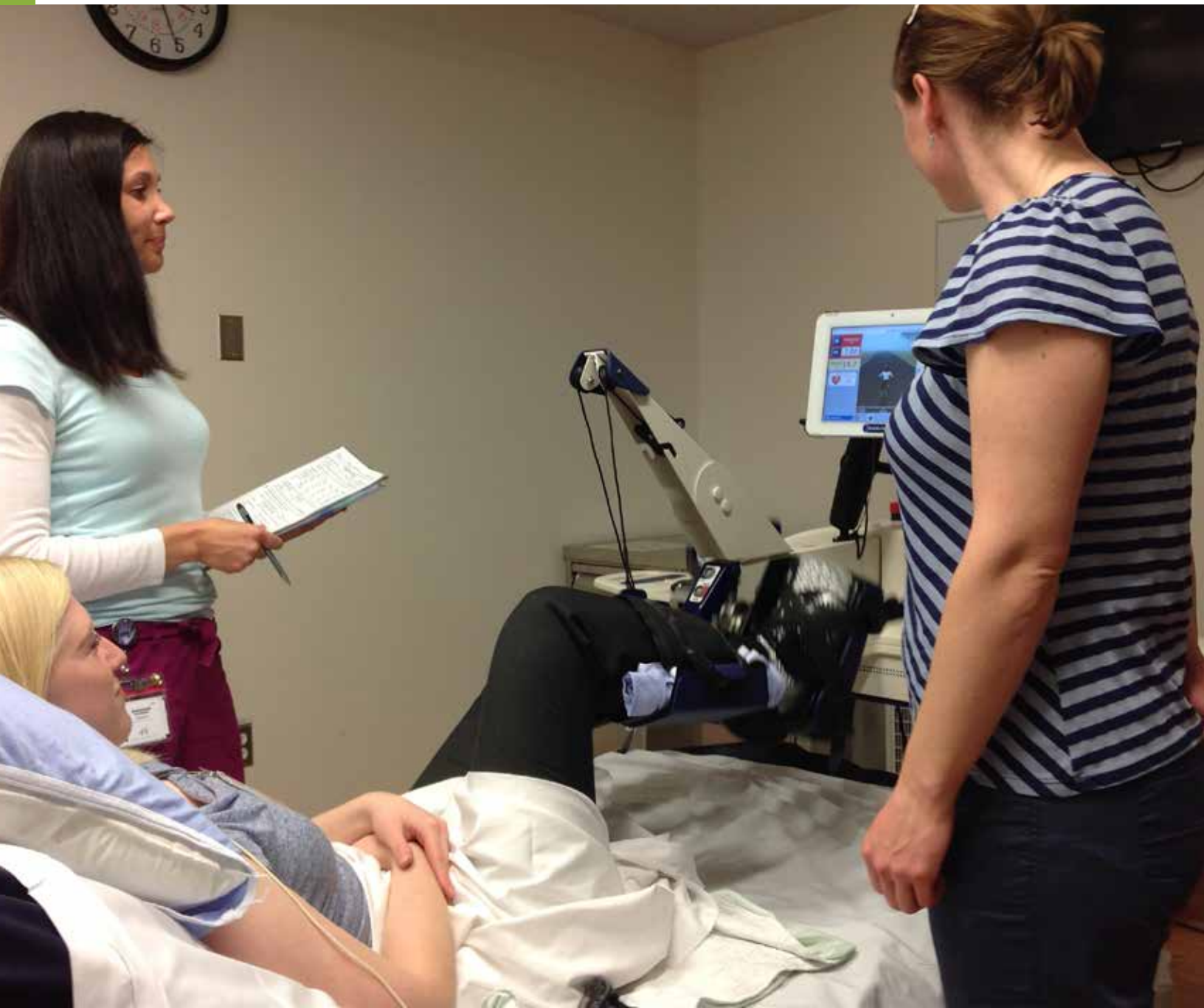


**Technology in Rehabilitation:**

# In-Bed Cycling as a Tool for Early Rehabilitation in the Intensive Care Unit



**Janelle Unger**, BSc Kin (Honours), MScPT student, CPA Member since 2015  
**Magda McCaughan**, MScPT, CPA Member since 2005  
**Alexander J. Molloy**, BHSc Kin  
**Beverley Cole**, PT, BScPT, MSc, MBA  
**Michelle E. Kho**, PT, PhD

## Technology can be a helpful rehabilitation tool in the ICU, and therapists should understand the benefits of using technology that can fit the specific needs of a critically ill patient

**Patients who survive critical illness often experience long-term functional limitations that can last up to five years after surviving an intensive care unit (ICU) stay.**<sup>1</sup> The ICU offers a unique challenge to physiotherapists, as many patients are mechanically ventilated (MV), sedated, and connected to numerous catheters and devices. This environment may pose potential barriers that limit patients' mobility; indeed, in one study, sedation was the greatest barrier to early mobilization in the ICU and 84% of patients on MV did not receive any mobilization within the first two weeks of ICU stay.<sup>2</sup> Immobility results in muscle atrophy, weakness, and cardiovascular deconditioning,<sup>3</sup> and up to 55% of patients show clinically evident weakness after receiving MV.<sup>4</sup> The loss of muscle mass occurs rapidly during the first 10 days of an ICU stay,<sup>5</sup> so targeting patients early in their ICU stay is critical. In Canada, the number of ICU patients is expected to increase, and with this, more survivors at risk of post-ICU disability. From 2011-2026, the demand for ICU services will expand by 40%,<sup>6</sup> resulting in increased health care costs.<sup>7</sup>

In a recent systematic review, exercise or physiotherapy were the most effective interventions to improve long-term physical function in critically ill patients, versus other ICU interventions such as nutrition, MV, or sedation strategies.<sup>8</sup> Implementing early rehabilitation in patients who are receiving MV or sedative medications is safe; adverse events are rare and usually minor.<sup>9</sup> Two

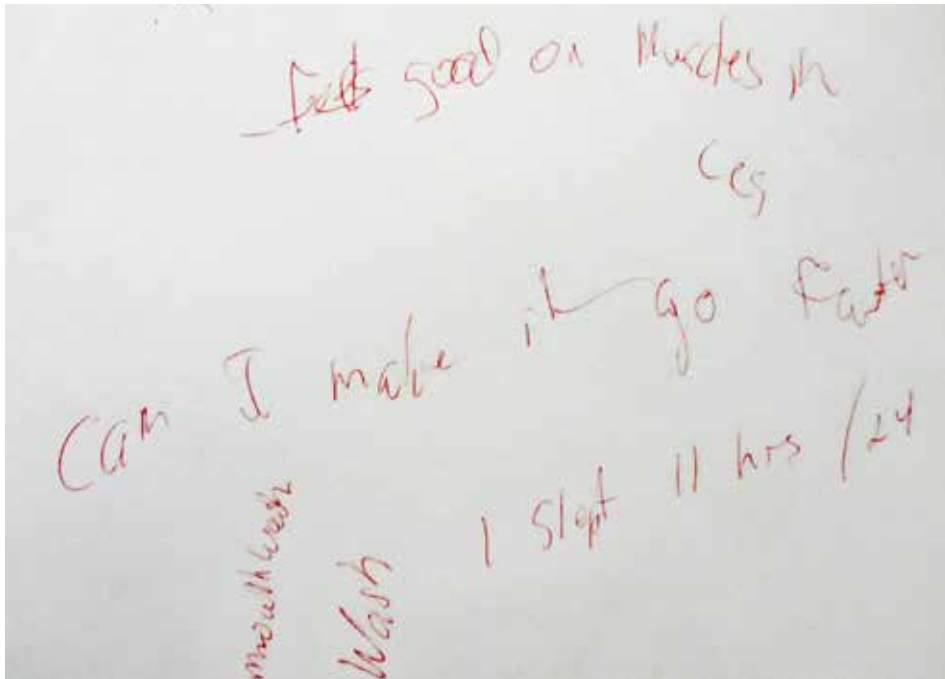
randomized clinical trials (RCTs) support therapy started in the ICU. In a landmark RCT of 104 patients enrolled within 72 hours of MV, investigators compared patients who received early exercise and mobilization with physiotherapy and occupational therapy, versus those who received standard care. Patients receiving early intervention achieved mobility milestones such as sitting at the edge of the bed, standing, marching in place, transferring to a chair, and walking, even while receiving MV, faster than patients in the standard care group who did not start therapy until approximately a week after ICU admission.<sup>10</sup> Importantly, more patients receiving early mobilization were able to perform independent activities of daily living (ADLs) and walk independently at hospital discharge.<sup>10</sup>

Technology can be a helpful rehabilitation tool in the ICU, and therapists should understand the benefits of using technology that can fit the specific needs of a critically ill patient.<sup>11</sup> A cycle ergometer is one example of technology (see picture 1), and was effective when started two weeks after ICU admission in patients with critical illness.<sup>12</sup> In an RCT of 90 patients in the ICU, those who received in-bed cycling walked farther on the 6 Minute Walk Test (6MWT) at hospital discharge, reported better physical function, and had stronger quadriceps force, than those who received respiratory physiotherapy and standard care.<sup>12</sup> In-bed cycling accommodates each individual's level of functional ability, as it has

options of active, active-assisted, or passive modes. Passive cycling offers mobilization for ICU patients that may not otherwise be able to participate in active therapy, such as those receiving sedation.<sup>11</sup> For patients who can actively participate, therapists can adjust the intensity of treatment throughout each session by adding resistance or challenging patients to cycle faster.<sup>12</sup> In-bed cycling provides us the novel ability to begin rehabilitation at the most critical time for patients, which may allow us to attenuate the negative impact of immobility. However, to date, no one has studied the effects of starting in-bed cycling within the first few days of ICU admission, which is a gap that our current research project addresses.

The CYCLE (Critical Care Cycling to Improve Lower Extremity Strength) Research Program is the first study of its kind in Canada. We provide critically ill patients with the opportunity to receive in-bed cycling very early in their ICU stay using technology like the RT300 supine cycle (Restorative Therapies, Baltimore, MD). The aim of CYCLE is to study whether early exercise using in-bed cycling, started within the first four days of MV and first seven days of ICU admission, helps patients recover faster from their ICU stay. This project is a multi-phase, interdisciplinary program that includes significant preparatory work leading toward a multi-center RCT. CYCLE research to-date includes a retrospective chart audit<sup>13</sup> and TryCYCLE, a prospective cohort study of the

*Pic. 1: Shivaun Davidson (BSc Kin, MScPT, Juravinksi Hospital) and Wendy Perry (MPT, St. Joseph's Healthcare) attend a therapist training session at St. Joseph's Healthcare ICU in Hamilton, to learn how to use the in-bed cycle ergometer, with Janelle Unger (MSc PT Student, McMaster University) in the role of simulated patient.*



*Pic. 2: Message written by a patient after an in-bed cycling session stating, "Feels good on muscles in legs" and "Can I make it go faster". The patient was orally intubated and was receiving mechanical ventilation during in-bed cycling. These comments show the patient's enjoyment of the treatment, as well as their motivation to be actively involved in rehabilitation in the ICU.*

safety and feasibility of early in-bed cycling.<sup>14</sup>

Our current study is the CYCLE pilot RCT, where we are studying the feasibility of in bed cycling in seven hospitals across Ontario. Participating ICUs include three in Hamilton: St. Joseph's Healthcare (lead site), Juravinski Hospital, and Hamilton General Hospital; 2 sites in Toronto: Toronto General Hospital, and St. Michael's Hospital; London Health Sciences Centre (Victoria Hospital), and The Ottawa Hospital (General Campus). To our knowledge, no studies of early rehabilitation in the ICU have occurred in this many centres, making the CYCLE pilot RCT the largest multi-centre study in the field. We are very proud to facilitate the use of this technology in ICUs across the province to study the effect of cycling on the functional independence of our patients after they leave our care. The CYCLE pilot RCT is funded by the Canada Foundation for Innovation, Ontario Ministry of Research and Innovation, Technology Evaluation in the Elderly Network, Ontario Thoracic Society, Canadian Respiratory Research Network Emerging Research Leaders Initiative, Canadian Institutes of Health Research, and Canada Research Chairs. We are also grateful to Restorative Therapies (Baltimore, MD) for the loan of two in-bed cycle ergometers for our research and invaluable collaboration with the Canadian Critical Care Trials Group.

The CYCLE Research Program has created many opportunities within the physiotherapy community and for critical care clinicians. To date, over 70 frontline PTs have been involved with CYCLE, including both ICU physiotherapists (who provide the randomized intervention, either biking or routine care, and measure strength and function) and ward therapists who follow the patients after ICU discharge and conduct blinded functional assessments. Input from these clinicians is crucial for refinement of the study, making in-bed cycling more efficient and effective as a tool during early rehabilitation. CYCLE has offered frontline therapists numerous professional development opportunities, including use of cutting-edge technology, direct contributions to knowledge generation, and exposure to practical outcome measures suitable for use across the acute care continuum. It has fostered relationships among the critical care team, including intensivists and researchers, and furthers the academic mission of participating institutions.

Locally, we have involved graduate students in CYCLE, including a unique emerging role clinician-scientist trainee MSc PT placement with McMaster University in the Physiotherapy department at St. Joseph's Healthcare Hamilton, and a clinician-scientist PhD candidate in the McMaster University School of Rehabilitation Science. The PT emerging role placement exposes a

second year student to working with a frontline clinician in the ICU and learning how to conduct clinical research as part of the CYCLE Research Program from one of the few ICU physiotherapist clinician-scientists in the world. It has been exciting to watch CYCLE open so many doors and create connections within the field of critical care rehabilitation, and our hope is that it will continue to do so in the future.

Most importantly, patients enjoy in-bed cycling (see picture 2). By offering a rehabilitation study very early in their ICU admission, we offer patients and their family members hope. Knowing that early rehabilitation for patients receiving MV in the ICU is safe<sup>15</sup> and effective,<sup>10</sup> and that in-bed cycling shows promising results for critically ill patients,<sup>12</sup> we are looking forward to the next phase of CYCLE. Using the feasibility data from the CYCLE pilot RCT, the full CYCLE RCT will determine the effectiveness of in-bed cycling as an early intervention for critically ill patients. To advance the study of critically ill patients, larger multi-centre studies are needed, as well as longer follow-up periods to provide information about patients' functional independence after they have returned home.<sup>8</sup> We look forward to bringing more clinicians together as we optimally prepare them to lead the future full-scale RCT, and provide patients the opportunity to receive in-bed cycling technology as part of their recovery from critical illness. 🦋

*For the complete list of references used in this article, please visit [www.physiotherapy.ca/Practice-Resources/Publications/Physiotherapy-Practice](http://www.physiotherapy.ca/Practice-Resources/Publications/Physiotherapy-Practice)*